

Product Review

The Clegg FM-DX Two-Meter FM Transceiver

The popularity of 2-meter fm is such that a person just getting into this aspect of amateur radio can be hard put to pick out a suitable transceiver. To say that the market is loaded would be an understatement. By the same token we see plenty of transceivers come in to ARRL hq. for product review so one tends to get a little blasé. But every once in a while, a unit will show up that makes us perk up. The FM DX 2-meter transceiver, a completely American-made product, is just such a radio.

For example, most transceivers are in the 1- to 10-watt class and many amateurs feel they must add amplifiers to obtain desired power levels. The FM-DX is rated at 35-watts output (the unit we tested showed 38 watts). One certainly doesn't need "shoes" when using this piece of gear. But for those users who don't want to run "high" power all the time the FM-DX also has a 500-milliwatt position.

The transceiver is completely solid state and employs digital technology using a phase-locked loop scheme to provide frequency coverage from 143.5 to 148.5 MHz. This extended frequency range provides coverage for non-amateur users, as well as the two-meter amateur frequencies, in 5-kHz steps. A six-digit direct-frequency readout is provided using numeric LEDs. The desired frequency is selected by setting four rotary switches. The first position sets the one-MHz steps, the second switch sets the 100-kHz steps, the next takes care of the ten-kHz settings and the last, five kHz.

Another switch is used to select the differential between transmit and receive, either plus or minus 600 kHz, using the standard international repeater pairings. In addition, simplex operation is provided plus three additional switch settings for non-standard frequencies, up to and including any input/output spread of 4.5 MHz.

The heart of the FM-DX is the frequency control system which uses a digital frequency synthesizer. A digital counting technique and a phase-locked voltage-controlled oscillator (VCO) is used for direction generation of the injection signal for the receiver. The same



VCO output is combined in a mixer along with the output of a crystal oscillator to obtain the transmitter frequency. In other words, the transmit frequency is always slaved to the receive frequency, a desirable feature. The VCO operates over a range from 33.2 to 34.45 MHz. The output is multiplied by four to give a range of 132.8 to 137.8 MHz, the receiver injection frequency (10.7-MHz i-f).

At the same time, the VCO frequency is divided by four to yield a signal between 8300 and 8612.5 kHz. This signal feeds five cascaded programmable counters. The net count of these counters can be programmed by the switches (panel mounted) described earlier. The switches can be set up so that they divide the input frequency by a selected number from 13,280 to 13,780. Output from the divider string provides one of two inputs to a phase detector. The second input is a fixed 625-Hz signal derived from a precise 4000-kHz crystal oscillator and a fixed divide-by-6400 digital circuit.

The phase detector (MC4044) is of the type wherein a steady-state voltage exists only when both input and output signals are identical in both frequency and phase. In this application, this condition is satisfied only when the divided-down VCO frequency equals the 625-Hz reference frequency.

To illustrate how this works assume that the programmable divider is set to divide by 13,600. The phase detector filtered and amplified output will force the VCO to $13,600 \times 4 \times 625$ Hz or 34,000 kHz. If the VCO tends to drift higher, the 625-Hz resultant will also increase and the phase detector will respond with a corrective output voltage returning the VCO to the correct frequency. With the VCO locked on 34.0 MHz the receiver will be tuned to $34.0 \times 4 + 10.7$ or 146.70 MHz.

The FM-DX controls and LED display have been programmed to do the above arithmetical computation internally. Consequently, when the received frequency controls are switched so that 146.70 is displayed on the LEDs, the divider is automatically set to the corresponding 13,600 value and the receiver is tuned to 146.70 MHz.

The transmit frequency is produced by combining two signals in a double-balanced mixer, one signal from the second harmonic of the VCO and the other from the output of a switchable crystal oscillator. The sum of these two frequencies is doubled in frequency and becomes the transmitter output frequency.

For example, using the receive frequency of 146.70 MHz, the VCO is therefore at 34.0 MHz. This VCO frequency is then doubled to 68 MHz and is applied to the doubly balanced mixer. The crystal oscillator is on 5.35 MHz and is also applied to the mixer. The mixer output, at 73.35 (68.0 plus 5.35), is amplified and doubled to 146.70 MHz which gives us simplex operation. If the crystal oscillator is switched to 5.05 MHz the resulting transmit signal is at 146.10 MHz, 600 kHz offset from the receive frequency.

Receiver Features

The receiver section of the FM-DX consists of two modules. The first module houses a MOSFET rf stage with a four-pole high-Q band-pass filter and a MOSFET mixer to the 10.7 MHz i-f, followed by a four-pole monolithic crystal filter. The second module includes two 10.7-MHz amplifier stages followed by another four-pole crystal filter. The remainder of the module contains the discriminator, limiter, audio and squelch circuits.

Of course, with any piece of gear, the final judgment is made when an amateur uses the equipment. In the Hartford area, it is possible to trigger up (and listen to) most of the repeater channels, including splits. In the reviewer's experience, the FM-DX was outstanding as far as handling adjacent channel interference — we observed none. This is certainly not true of some other makes we have tried.

We did have one complaint but that didn't concern performance. The six-digit LED readouts used are great at night or out of direct sunlight. However, on any bright day it is well nigh impossible to read the darn things. In any case, the FM-DX is easy to set on frequency — you can always count the clicks on the frequency-setting switches. In fact, we recommend this method rather than looking at the LEDs while in motion or you are not likely to be in motion long!

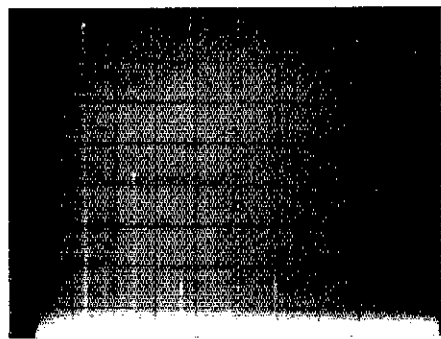
In summing up, the reviewer is impressed with the heavy-duty construction of the FM-DX. There has been some talk lately that it would be a real problem to design a transceiver that would cover *all* of the 2-meter band without the operator having to retune the unit. We checked the power output from the FM-DX from 143.5 to 148.5 MHz. The variation from 40-watts output was *less* than 2 watts across the frequency range, which speaks very well for the unit. As far as this reviewer is concerned, the FM-DX gets a high rating. — *W1ICP*

Clegg FM-DX 2-Meter Transceiver

Dimensions (HWD): 3-1/8 × 7 × 11-1/2 inches.

Weight: 7-1/2 pounds.

Power requirements: 13.5-13.8 V dc (recommended), approximately 110 watts current drain in high-power transmit position,



Spectrum-analyzer display of the FM-DX output. Vertical scale: 10 dB/div. Horizontal scale: 50 MHz/div. Power output: 40 watts.